

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Claims 1-24 (Cancelled)

Claim 25 (Currently Amended): An apparatus for the discrimination of a matter utilizing electrophoretic and acoustic forces in field flow fractionation, which apparatus comprises:

a) a chamber having at least one inlet port and at least one outlet port, said chamber having such structural characteristics that when a carried medium is caused to travel through said chamber, the traveling velocity of said carried medium at various positions within said chamber is different;

b) at least two electrode elements non-movably adapted along a portion of said chamber, wherein said electrode elements can be energized via at least one electrical signal provided by an electrical signal generator to create an electrical field, thereby causing at least one electrophoretic force having components normal to the traveling direction of said carrier medium on a matter in said carrier medium; and

c) at least one piezoelectric transducer non-movably adapted along a portion of said chamber, wherein said piezoelectric transducer can be energized via at least one electrical signal provided by an electrical signal generator to create an acoustic wave, thereby causing at least one acoustic force having components normal to the traveling direction of said carrier medium on a matter in said carrier medium.

Claim 26 (Original): The apparatus of claim 25, which comprises more than two electrode elements.

Claim 27 (Original): The apparatus of claim 25, wherein each of more than two electrode elements is individually connected to one of a plurality of electrical conductor buses electrically connected to the electrical signal generator.

Claim 28 (Original): The apparatus of claim 25, wherein the electrode elements are adapted substantially longitudinally or latitudinally along a portion of the chamber.

Claim 29 (Original): The apparatus of claim 25, wherein the electrode elements are adapted along the interior surface of the chamber.

Claim 30 (Original): The apparatus of claim 25, wherein the electrode elements are configured on a plane substantially parallel to the traveling direction of carrier medium caused to travel through said chamber.

Claim 31 (Original): The apparatus of claim 25, wherein the electrode elements form an electrode array, said electrode array is selected from an interdigitated electrode array, interdigitated castellated electrode array, interdigitated electrode array having periodic triangular-shaped tips on the electrode elements, interdigitated electrode array having periodic arc-shaped tips on the electrode elements.

Claim 32 (Original): The apparatus of claim 25, wherein the electrode elements are a metal layer coated on a surface of the chamber.

Claim 33 (Original): The apparatus of claim 32, wherein the metal is selected from a group of gold, platinum, aluminum, chromium, titanium, copper and silver.

Claim 34 (Original): The apparatus of claim 25, wherein the electrical signal generator for energizing the electrode elements to create the electrophoretic force is a DC signal source capable of varying magnitude of DC voltage, or is a AC signal source capable of varying magnitude and frequency, of said electrical signals.

Claim 35 (Original): The apparatus of claim 25, wherein the electrical signal for energizing the electrode elements to create the electrophoretic force is a DC electrical signal or a low-frequency-AC signal.

Claim 36 (Original): The apparatus of claim 25, wherein the chamber comprises a tube.

Claim 37 (Original): The apparatus of claim 36, wherein the electrode elements and/or the piezoelectric transducer, or a plurality thereof, are adapted along the interior surface of the tube.

Claim 38 (Original): The apparatus of claim 36, wherein the electrode elements and/or the piezoelectric transducer, or a plurality thereof, are adapted along the exterior surface of the tube.

Claim 39 (Original): The apparatus of claim 25, wherein the chamber comprises a top wall, a bottom wall, and two side walls and the electrode elements and/or the piezoelectric transducer, or a plurality thereof, are configured on the top wall of the chamber.

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Claim 40 (Original): The apparatus of claim 25, wherein the chamber comprises a top wall, a bottom wall, and two side walls and the electrode elements and/or the piezoelectric transducer, or a plurality thereof, are configured on the bottom wall of the chamber.

Claim 41 (Original): The apparatus of claim 25, wherein the electrode elements and/or the piezoelectric transducer, or a plurality thereof, is adapted on opposing surfaces of the chamber.


Claims 42 and 43 (Cancelled)

Claim 44 (Currently Amended): An apparatus for the discrimination of a matter utilizing dielectrophoretic and acoustic forces in field flow fractionation, which apparatus comprises:

a) a chamber having at least one inlet port and at least one outlet port, said chamber having such structural characteristics that when a carried medium is caused to travel through said chamber, the traveling velocity of said carried medium at various positions within said chamber is different;

b) at least two electrode elements non-movably adapted along a portion of said chamber, wherein said electrode elements can be energized via at least one electrical signal provided by an electrical signal generator to create a non-uniform electrical field, thereby causing at least one dielectrophoretic force having components normal to the traveling direction of said carrier medium on a matter in said carrier medium; and

c) at least one piezoelectric transducer non-movably adapted along a portion of said chamber, wherein said piezoelectric transducer can be energized via at least one electrical signal provided by an electrical signal generator to create an acoustic wave, thereby causing at least one acoustic force having components normal to the traveling direction of said carrier medium on a matter in said carrier medium.

 Claim 45 (Original): The apparatus of claim 44, which comprises more than two electrode elements.

Claim 46 (Original): The apparatus of claim 45, wherein each of more than two electrode elements is individually connected to one of a plurality of electrical conductor buses electrically connected to the electrical signal generator.

Claim 47 (Original): The apparatus of claim 45, wherein the electrode elements further creates a spatially inhomogeneous electric field.

Claim 48 (Original): The apparatus of claim 44, wherein the electrical signal generator for energizing the electrode elements to create the dielectrophoretic force is capable of varying magnitude, and frequency of said electrical signals.

Claims 49-64 (Cancelled)

Claim 65 (Original): A method of discriminating a matter using electrophoretic and acoustic forces in field flow fractionation, which method comprises:

a) obtaining an apparatus of claim 25;

b) introducing a carrier medium containing a matter to be discriminated into the chamber of the apparatus of claim 25 via its inlet port, wherein said introducing causes the carrier medium to travel through the chamber according to a velocity profile;

c) applying at least one electrical signal provided by an electrical signal generator to the electrode elements, wherein said energized electrode elements create an electrical field, thereby causing at least one electrophoretic force on said matter having components normal to the ~~travelling~~ traveling direction of said carrier medium ~~travelling~~ traveling through said chamber; and

d) applying at least another electrical signal provided by an electrical signal generator to the piezoelectric transducer, wherein said energized piezoelectric transducer creates an acoustic wave, thereby causing at least one acoustic force on said matter having components normal to the traveling direction of said carrier medium ~~travelling~~ traveling through said chamber;

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whereby said matter is displaced to positions within said carrier medium along a direction normal to the traveling direction of said carrier medium ~~travelling~~ traveling through said chamber and discriminated according to its position within said carrier medium along the direction normal to the traveling direction of said carrier medium ~~travelling~~ traveling through said chamber.

Claim 66 (Original): The method of claim 65, wherein the electrophoretic force and the acoustic force are generated simultaneously.

Claim 67 (Original): The method of claim 65, wherein the electrophoretic force and the acoustic force are generated sequentially.

Claim 68 (Original): A method of discriminating a matter using electrophoretic and acoustic forces in field flow fractionation, which method comprises:

- a) obtaining an apparatus of claim 25;
- b) loading a carrier medium into the chamber of apparatus of claim 25 via its inlet port until the chamber is filled with the carrier medium;

c) delivering a sample that contains a matter to be discriminated into the carrier medium in the chamber;

d) applying at least one electrical signal provided by an electrical signal generator to the electrode elements, wherein said energized electrode elements create an electrical field, thereby causing at least one electrophoretic force on said matter;

e) applying at least another electrical signal provided by an electrical signal generator to the piezoelectric transducer, wherein said energized piezoelectric transducer creates an acoustic wave, thereby causing at least one acoustic force on said matter;

f) introducing the carrier medium into the chamber of the apparatus via its inlet port, wherein said introducing causes the carrier medium to travel through the chamber according to a velocity profile;

whereby said matter is displaced to positions within said carrier medium along a direction normal to the traveling direction of said carrier medium ~~travelling~~ traveling through said chamber and discriminated according to its position within said carrier medium along the direction normal to the traveling direction of said carrier medium ~~travelling~~ traveling through said chamber.

Claim 69 (Original): The method of claim 68, wherein applying electrical signal to the electrode elements to cause at least one electrophoretic force on said matter and applying electrical signal to the piezoelectric transducer to cause at least one acoustic force on said matter result in the matter being displaced into equilibrium position along a direction normal to the traveling direction of the carrier medium traveling through the chamber, prior to the introducing of carrier medium into the chamber that causes the carrier medium to travel through the chamber according to a velocity profile.

Claim 70 (Original): The method of claim 68, wherein the electrophoretic force and the acoustic force are generated simultaneously.

Claim 71 (Original): The method of claim 68, wherein the electrophoretic force and the acoustic force are generated sequentially.

Claim 72 (Original): A method of discriminating a matter using dielectrophoretic and acoustic forces in field flow fractionation, which method comprises:

- a) obtaining an apparatus of claim 44;
- b) introducing a carrier medium containing a matter to be discriminated into the chamber of the apparatus of the claim 44 via its inlet port, wherein said introducing causes the carrier medium to travel through the chamber according to a velocity profile;
- c) applying at least one electrical signal provided by an electrical signal generator to the electrode elements, wherein said energized electrode elements create a non-uniform electrical field, thereby causing at least one dielectrophoretic force on said matter having components normal to the traveling direction of said carrier medium ~~travelling~~ traveling through said chamber; and
- d) applying at least another electrical signal provided by an electrical signal generator to the piezoelectric transducer, wherein said energized piezoelectric transducer creates an acoustic wave, thereby causing at least one acoustic force on said matter having components normal to the traveling direction of said carrier medium ~~travelling~~ traveling through said chamber;

whereby said matter is displaced to positions within said carrier medium along a direction normal to the traveling direction of said carrier medium ~~travelling~~ traveling through said chamber and discriminated according to its position within said carrier medium along the direction normal to the traveling direction of said carrier medium ~~travelling~~ traveling through said chamber.

Claim 73 (Original): The method of claim 72, wherein the dielectrophoretic force and the acoustic force are generated simultaneously.

Claim 74 (Original): The method of claim 72, wherein the dielectrophoretic force and the acoustic force are generated sequentially.

Claim 75 (Original): A method of discriminating a matter using dielectrophoretic and acoustic forces in field flow fractionation, which method comprises:

- a) obtaining an apparatus of claim 44;

b) loading a carrier medium into the chamber of the apparatus of claim 44 via its inlet port until the chamber is filled with the carrier medium;

c) delivering a sample that contains a matter to be discriminated into the carrier medium in the chamber;

d) applying at least one electrical signal provided by an electrical signal generator to the electrode elements, wherein said energized electrode elements create an electrical field, thereby causing at least one dielectrophoretic force on said matter;

e) applying at least another electrical signal provided by an electrical signal generator to the piezoelectric transducer, wherein said energized piezoelectric transducer creates an acoustic wave, thereby causing at least one acoustic force on said matter;

f) introducing the carrier medium into the chamber of the apparatus via its inlet port, wherein said introducing causes the carrier medium to travel through the chamber according to a velocity profile;

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whereby said matter is displaced to positions within said carrier medium along a direction normal to the traveling direction of said carrier medium ~~travelling~~ traveling through said chamber and discriminated according to its position within said carrier medium along the direction normal to the traveling direction of said carrier medium ~~travelling~~ traveling through said chamber.

Claim 76 (Original): The method of claim 75, wherein applying electrical signal to the electrode elements to cause dielectrophoretic force on said matter and applying electrical signal to the piezoelectric transducer to cause acoustic force on said matter result in the matter being displaced into equilibrium position along a direction normal to the traveling direction of the carrier medium traveling through the chamber, prior to the introducing of carrier medium into the chamber that causes the carrier medium to travel through the chamber according to a velocity profile.

Claim 77 (Original): The method of claim 75, wherein the dielectrophoretic force and the acoustic force are generated simultaneously.

Claim 78 (Original): The method of claim 75, wherein the dielectrophoretic force and the acoustic force are generated sequentially.

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